
Space Weather Technical Forecast

Issued on Friday, 02 February 2024 at 13:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of isolated M-flares. CME glancing blow possible late Day 2 or early Day 3 (03-04 Feb), with a chance of G1/Minor geomagnetic storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with AR3571 producing an M1.1 flare at 02/0301 UTC. There are now eight sunspot regions on the disc, with AR3575 having developed and been numbered in recent hours. AR3567 in the northeast has been fading in area and complexity over recent hours. AR3565 near north centre disc still shows moderate magnetic complexity, but is also fading somewhat. AR3571 in the southeast is difficult to analyse near the limb and appears simple, but was responsible for the recent M-flare. The other regions appear mostly fairly small and simple at present.

Further analysis has been done on the CME associated with a C3 flare from near north centre disc peaking at 01/0743 UTC, with this now considered most likely to only give a glancing blow at Earth, probably early on 04 Feb. Several other CMEs have been seen in coronagraph imagery, but none are considered likely to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR and ACE at L1, were mostly at background levels, with CME effects having waned. Wind speeds declined from slightly elevated to background levels, from around 420 km/s to near 350 km/s. The density was average or below. The interplanetary magnetic field, Bt, was weak at 5nT or below. The north-south component, Bz, varied weakly between +3/-4 nT. The Phi angle was mostly negative (towards the Sun), but started varying towards positive (away from the Sun) after 02/0600 UTC. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is currently slightly elevated above normal background levels following the M6.8 flare on 29 Jan from Ex-AR3559, but remains well below the S1/Minor Radiation Storm threshold.

GOES16 high energy (greater than 2MeV) electron flux was at normal background to moderate levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold but on a slight rising trend. At 02/0000 UTC the 24-hour integrated fluence observation was 5.2e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Overall activity is most likely to be Low, but with an increasing chance of further isolated M-flares.

Solar Wind / Geomagnetic Activity: A CME which left the Sun at 01/0743 UTC has been re-analysed. This analysis suggests the possibility of a glancing blow either later on Day 2 (03 Feb) or more likely early on Day 3 (04 Feb). In addition there may be also be a High Speed Stream (HSS) enhancement, from CH96/+ in the southern hemisphere, during this period. The majority of the HSS arrival is expected to be on Day 3 or Day 4 (04-05 Feb), with solar wind speeds perhaps reaching 450-500 km/s. At this time of year any response to positive polarity coronal holes is expected to be muted.

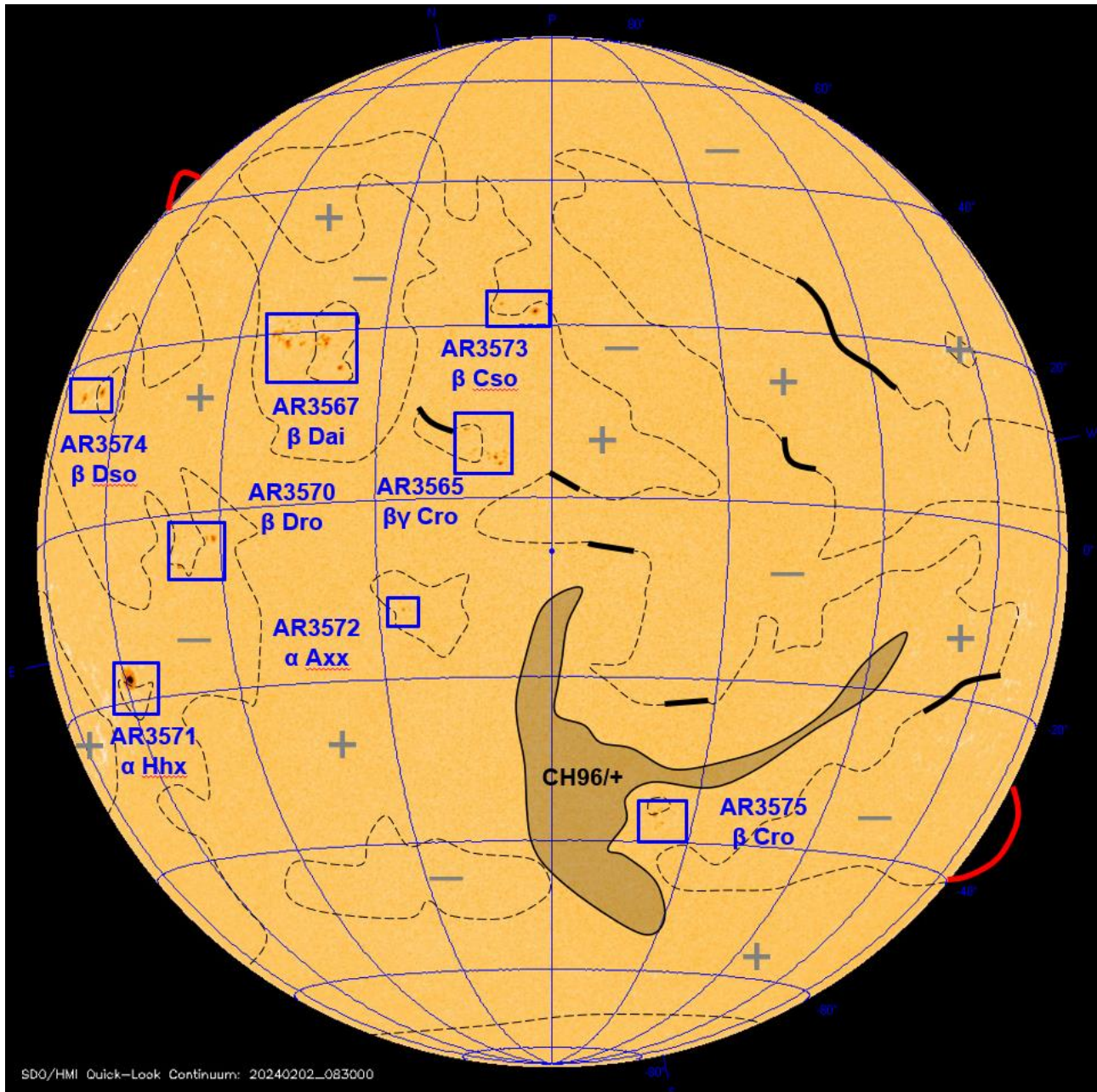
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Geomagnetic activity is expected to remain Quiet to Unsettled (Kp 0-3) today. From later tomorrow, the potential for glancing CME effects means that there is a chance of Active to G1/Minor Storm intervals, perhaps with a slight chance of G2/Moderate Storm intervals should any CME and HSS effects combine. Activity should then decline through Day 4.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain below the S1/Minor Radiation Storm level, with a very slight chance of exceeding the S1 threshold during the period.

The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active fluence threshold considered unlikely.

Figure 1. Solar Analysis Valid 02/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME which originated from an area of plage near north centre disc, associated with a long period C3 flare which peaked at 01/0743 UTC, has been re-analysed. This analysis suggests that the bulk of the CME is expected to pass above Earth's orbit, but with the possibility of a glancing blow either later on Day 2 (03 Feb) or more likely early on Day 3 (04 Feb).

In addition there may be also be a High Speed Stream (HSS) enhancement, from CH96/+ in the southern hemisphere, during this period. A thin and narrow extension of this CH may become weakly geo-effective from Day 2 but the majority of the HSS arrival is expected to be on Day 3 or Day 4 (04-05 Feb), with solar wind speeds perhaps reaching 450-500 km/s. However, on the previous rotation, wind speeds barely reached 450 km/s with little geomagnetic response. At this time of year any response to positive polarity coronal holes is expected to be muted.

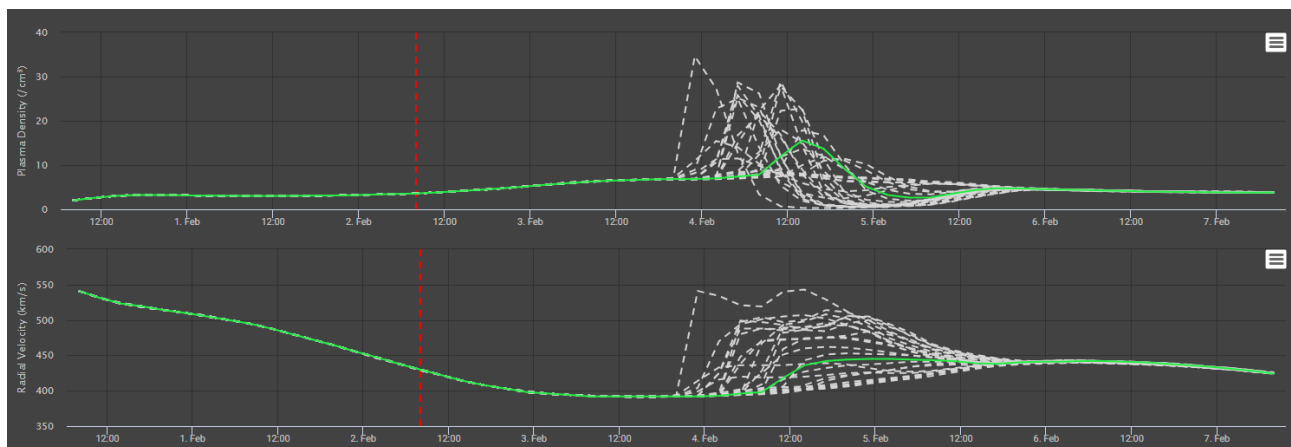
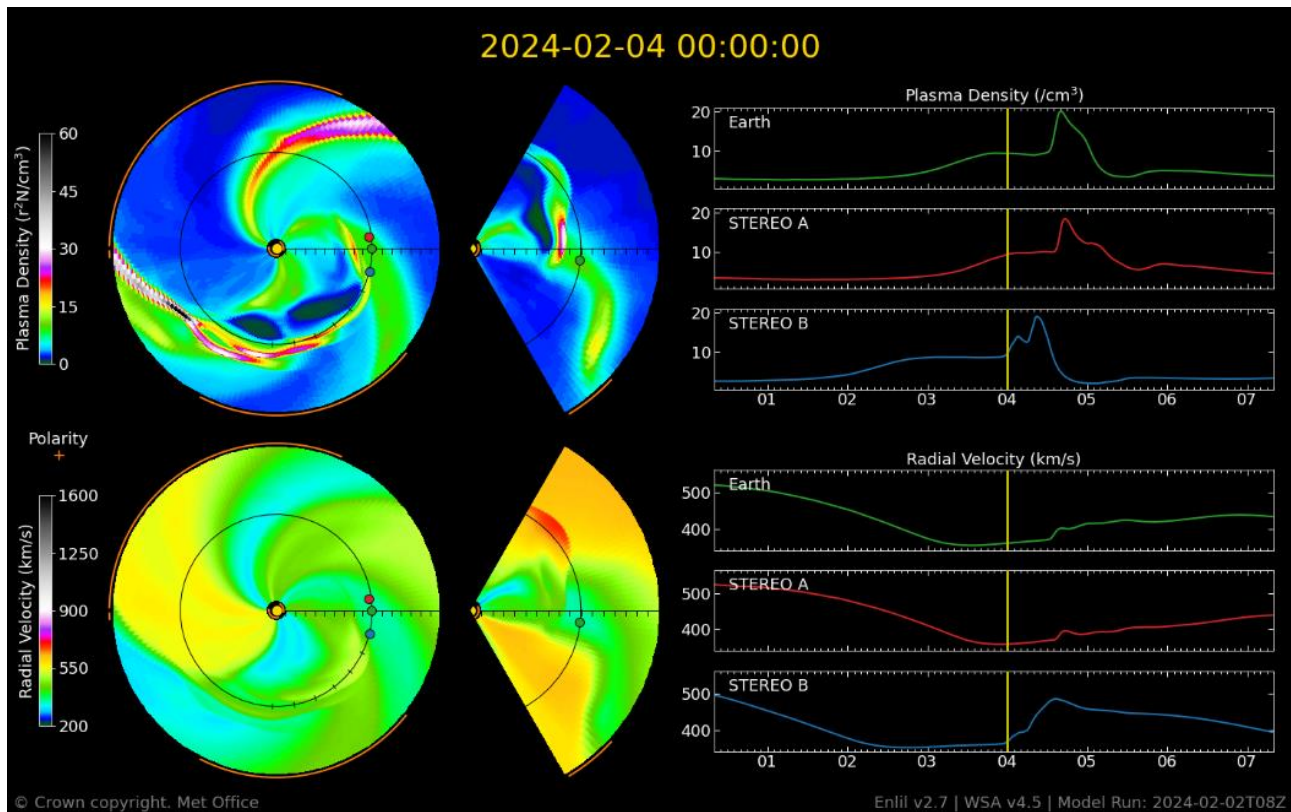
Geomagnetic activity is expected to remain Quiet to Unsettled (Kp 0-3) today. From later tomorrow, the potential for glancing CME effects means that there is a chance of Active to G1/Minor Storm intervals, perhaps with a slight chance of G2/Moderate Storm intervals should any CME and HSS effects combine. Activity should then decline through Day 4.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	20	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1245	Partial	Plage area	NE	720 km/s	04/0600 UTC	Glancing blow possible

Figure 2: MOSWOC Enlil and ensemble, showing a potential CME arrival early on 04 Feb.



Radio Blackouts - X-Ray Flares:

Solar activity is Moderate, with AR3571 producing an M1.1 flare at 02/0301 UTC.

There are now eight sunspot regions on the disc, with AR3575 having developed and been numbered in recent hours. AR3567 in the northeast has been fading in area and complexity over recent hours. AR3565 near north centre disc still shows moderate magnetic complexity, but is also fading somewhat. AR3571 is difficult to analyse near the limb and appears simple, but was responsible for the recent M-flare. The other regions appear mostly fairly small and simple at present. Far side soundings and returning regions suggest there may be more regions to rotate onto the east limb, with SDO imagery suggesting a further region to rotate onto the southeast limb in the next day or so. Flare probabilities show a slight increase to reflect this.

Overall activity is most likely to be Low, but with an increasing chance of further isolated M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	35	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flux at GOES16 and 18, showing one M-flare from AR3571.



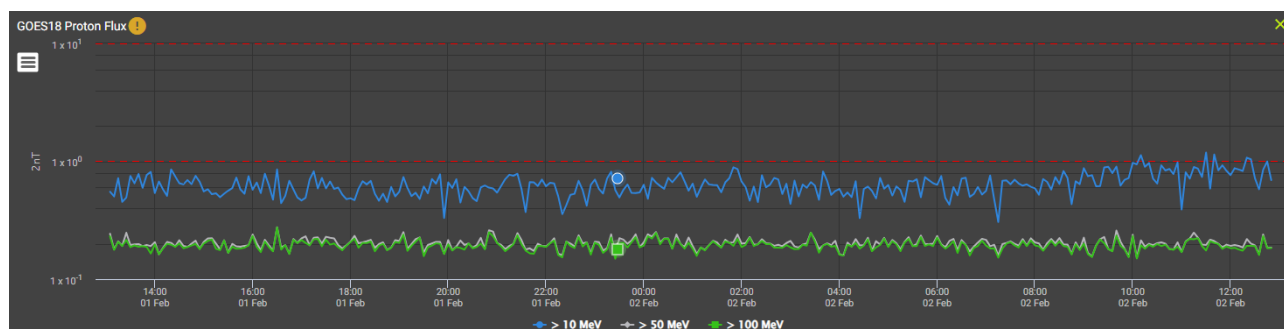
Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently slightly elevated above normal background levels following the M6.8 flare on 29 Jan from Ex-AR3559, but remains well below the S1/Minor Radiation Storm threshold. There is just a very slight chance of reaching S1 levels, should any of the regions on the disc produce any larger flares. AR3559 is now well beyond the west limb and no longer contributing significantly to the probability of increased proton flux.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	5	5	5	5
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 4: Proton flux at GOES18, with 10MeV protons just slightly elevated above normal background levels.



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) has been mostly at background levels, just reaching moderate at yesterday's diurnal maximum. Any CME or HSS effects during this period are most likely to be fairly weak, therefore not providing much input for an increase in electron flux. There is a very low risk of an increase later in the period, should there be a stronger response to the CME or HSS than expected.

Overall, the electron fluence is expected to remain well below the Active ($1\text{e}8$ integrated flux) threshold, perhaps with a slight rising trend later in the period. MOSWOC REFM's projections are currently underestimating the fluence, but still the overall below Active trend is thought to be a good guide.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM, showing a below Active forecast through the next three days.

